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1. View in narrow southern portion of Lake Burford. Broad-leaved cottonwood (*Populus wislizeni*) at left.
2. Shore of Lake Burford south of Chama Rod and Gun Club Cabin showing fringing growth of tules and sage grown knolls.

OBSERVATIONS ON THE HABITS OF BIRDS AT LAKE
BURFORD, NEW MEXICO.

BY ALEXANDER WETMORE.

Plates VII-IX

INTRODUCTION

Lake Burford, the largest natural body of water found in New Mexico, is situated in the Jicarilla (Apache) Indian Reservation in the northwestern part of the state. This lake for many years was known as Stinking Lake and is so shown on most maps, a name derived from the Spanish appellation, of "La Laguna Grande Hedi-onda" (so called from a spring of sulphur-tainted water near the western side). Recently the lake has been given much prominence as a possible breeding ground for water birds by various interested agencies and it was decided that it would be fitting to give it a more euphonious name. On May 3, 1918, therefore, by petition of the Southwestern Geographic Society and the New Mexico Game Protective association, it was rechristened Lake Burford, in honor of the late Miles W. Burford of Silver City, New Mexico, a gentleman who had been prominent as a pioneer in promoting the cause of game protection in the state.

The work on which the following notes are based was carried on in the interest of the Biological Survey, United States Department of Agriculture, and covered the period from May 23 to June 19, 1918. Through the kindness of Mr. H. L. Hall and Mr. C. McFadden of Chama, New Mexico, permission was received to occupy an adobe cabin at the lake, belonging to the Chama Rod and Gun Club, while Mr. P. G. Orell rendered aid in assembling needed camp equipment. I reached Chama on the afternoon of May 22, and left for Lake Burford at noon the following day after outfitting for a month's work in the field. Jimmy Barnett of Chama accompanied me as assistant in camp. The trip to the lake, made in a Ford auto truck, required four hours, a sufficient commentary on the state of the mountain roads, as the distance travelled was only about forty miles. Visits were made to a lumber camp at El Vado for mail and supplies on May 31 and June 12, and we returned to

Chama on June 19. Our stay at the lake extended over a period of four weeks.

PHYSICAL FEATURES

Lake Burford is located approximately at 7000 feet above sea level and lies in a trough or depression extending north and south near the summit of the Continental Divide. The lake covers an irregular basin surrounded by rolling knolls, that around most of the shore come down directly to the water. These are strewn with loose fragments of sandstone and overgrown with sage. In several places rocky promontories of yellowish white sandstone rise abruptly from the water's edge. Near these the lake bottom is hard and firm; elsewhere it is composed of soft black mud that is deep and treacherous. The shoreline in 1918 was between 15 and 17 miles in all, and the water surface extended over between 4 and 5 square miles. The northern end of the lake is broad and open, while the southern part is cut by projecting promontories into several small bays (Plate VII, fig 1). In the southern area are three small islands. The depth of the lake in the center varied from 6 to 9 feet. Lake Burford receives its water supply from snow water and rain, and to some extent from springs. In extremely high water it may overflow from a narrow east bay down a great cleft in the sandstone rock known as La Puerta Grande, that leads down toward the Chama (or Brazos) River, but within modern times the water content of the lake has not reached such a level. There is, however, an underground flow here that feeds two small lakes below the large one, and seepage continues on below these.

The waters of Lake Burford are distinctly alkaline, though the alkali is not concentrated, so that sheep, cattle and horses water here without trouble. Where low flats bordered the shore a thin alkaline scale or efflorescence formed on the surface of the mud, and isolated pools in such areas were found to be strongly saline. There was a decided difference in appearance in the water of the northern and southern parts of the lake. That in the broad, open northern portion was gray, murky and opaque, so that objects four inches below the surface were barely visible. The water in the southern end was clearer and contained less sediment, so that bottom might be seen at a depth of three feet. This difference

may be due in part to the presence of springs in the southern end (though none were located) and in part to the fact that the wind sweeps strongly across the open north end, so that the waves usually run high every afternoon and evening, a condition that would tend to keep the water roily.

The spring of 1918, had been very dry and the fall of snow during the previous winter below normal, so that at the time of my work the lake level was two and one half to three feet below that of last year. The water area varies greatly as the seasons change from year to year, and I was told that in the past ten years the water once had been down between 4 and 5 feet below its present level. During the spring months there is said to be a running stream in a small draw that reaches the lake on the northeastern side near the cabin (Plate VIII, fig. 2), but in 1918 this was dry. In some places Mexican sheep herders secured water for drinking from seep holes dug a few feet from the lake shore, but this was found to be too strong to be good, and for our use we carried water from some slightly alkaline pools located below a grove of large cottonwoods in the draw mentioned above. Later this seepage water became too bad, and further search revealed a small spring of good water four hundred yards above the cottonwoods.

The two small lakes formed by seepage from Lake Burford were about a mile and a half below the main lake. The first of these had an area of about 40 acres and was grown with *Scirpus occidentalis*. The second, known to the Mexicans as La Laguna de la Puerta, or La Laguna Thompson (named for Mr. Thompson of Chama, who formerly lived nearby), was a third of a mile long and an eighth of a mile broad. There was also a small lake 500 yards long by 100 yards broad situated northeast of the cabin, cut off by low knolls from Lake Burford, that was known as Hayden's or Clear Lake. Water birds of several species flew back and forth to these smaller lakes regularly.

It was said that Lake Burford was usually frozen over by the first of December, though ice formed along the shores earlier, and that the water was open again by the first of March. It was difficult, however, in the short time spent at Chama, to secure accurate information on this point as the lake has been remote from traveled paths and few have come here save in summer and fall. With-

in a short period Largo and Tapacitos Canyons to the west have been colonized and many more white people have come into this area. El Vado is the present railroad point from which these settlers receive supplies, and as the road to El Vado passes the lake, the region is becoming more frequented.

Conditions at the lake are such that spring is late and it was curious that when I arrived the season was farther advanced on the high pine covered slopes than lower down along the shore. From May 24 to June 5 the average morning temperature at 6:00 A. M. was about 40° F., while on May 26 and 27 ice was found in the rushes bordering the beaches. After June 5th it became warmer. Heavy winds from the west prevailed during May, but moderated later. At the time of my arrival black willows were beginning to bloom in protected places, and in a few spots along the lake shore small broad-leaved and narrow-leaved cottonwoods were in bud. Gray willows did not blossom until June 17th. By June 6th vegetation showed slight increase as growth, retarded by the cold nights, was slow. The breeding season for marsh birds (save the passerines) did not begin until about May 25 and was not at its height until June 10, while Eared Grebes had just begun their nest-building on June 18.

The work at Lake Burford was undertaken primarily to ascertain what species of water birds bred there and in approximately what numbers these occurred. Comparatively little collecting was done, as it was desired to disturb the birds as little as possible, but long hours each day were spent in observation, aided where necessary by the use of 8-power binoculars. The natural conditions at the lake were such as to render observation of the avian inhabitants a comparatively simple matter. A stand of dead tules remaining from last year bordered much of the shoreline, and the broken clumps of these rushes were just high enough to form a natural blind wherever I cared to sit down and watch. When observation at long distance was necessary other cover was available in the sagebrush on the knolls above. Most of the birds that occurred here were very tame and it was the ordinary thing to have them carry on the business of every day life, with no sign of fear or uneasiness, within 30 to 100 feet of me as I lay concealed in the rushes.

GENERAL CONDITIONS

The water of Lake Burford, while not bad, was at the same time distinctly alkaline as has been previously stated, so that the aquatic and semiaquatic vegetation was limited to those forms of plant life characterized by a marked tolerance for alkali. The round-stemmed bulrush or tule (*Scirpus occidentalis*) was the most prominent of these. Considerable areas along the south, west and north shores were entirely bare and open but elsewhere this plant formed a growth in the water, extending from the shoreline out for a distance of from one to fifty feet. In general it grew as a fringing band from six to ten feet broad (Plate VII, fig. 2). The dead stems of this tule formed dense masses, matted firmly by the winter's snow and ice, to be penetrated and traversed only with much trouble, a safe cover for many nests as the ducks were able to creep in underneath the interlaced stems and here conceal their eggs. On May 24 the new growth was just starting and much of it had been frost-bitten so that the tips showed as brown dead spikes. Two weeks later the new growth was extensive and formed an efficient cover (Plate VIII, fig. 1). New clumps were appearing in shallow open water also where all last year's growth had been destroyed by ice so that by the first of July the area covered by this plant must have been extensive.

Bayonet grass or three-square (*Scirpus paludosus*) was common and salt grass (*Distichlis spicata*) was abundant in suitable places along the shore where it grew with foxtail (*Hordeum jubatum*). Sage brush (*Artemisia tridentata*) covered all of the knolls and rolling slopes, in most places coming down to the beach. A linear leaved pondweed (*Potamogeton pectinatus*) was the most abundant of the truly aquatic plants and with it, clogging and enveloping its leaves, were great masses of a green alga. On May 23, when work was begun at the lake, the pondweed was appearing as scattered filaments on the floors of sheltered bays. As the water became warmer this growth increased and by June 18, it had begun to appear in large areas at the surface. By July 1, it must have covered practically the entire lake. Ditch-grass (*Ruppia occidentalis*) was found in the Laguna de la Puerta and a musk-grass (*Chara* sp.) was common in the spring holes from which we

secured drinking water. The cat-tail (*Typha latifolia*) was fairly common. A black and a gray willow grew at intervals along the lake shore, and both narrow-leaved and broad-leaved cottonwoods (*Populus angustifolia* and *P. wislizeni*) were found in small numbers (Plate IX, fig. 1). At a few points wild currant (*Ribes inebrians* and *R. aureum*), choke cherry (*Padus melanocarpa*) and service-berry (*Amelanchier*) were abundant in the hills and came down above the shore of the lake on protected north slopes. The yellow pine (*Pinus brachyptera*) grew in open forests over the higher hills (Plate IX, fig. 2) interspersed with pinyons and cedars which came down over the lower slopes. Douglas fir was found in some of the gulches and there were many groves of a small oak in valleys in the hills.

There were no fish of any species in the lake. The axolotl (*Ambystoma*) was abundant and was the source of food of mergansers and herons. The Mexican name of this curious creature was in common use, but was usually corrupted by Americans to "water loty." These creatures were observed lying on aquatic growth a foot or so beneath the surface, basking in the sun's rays, and at my approach turned with a quick wriggle and disappeared in the murky water below. In feeding on Chironomids resting on the surface film, these water dogs broke at the surface as fish might, and at such times seemed surprisingly active for creatures ordinarily considered so sluggish. During June they began to die in considerable numbers for no apparent reason (save perhaps that they had lived their allotted span of life) and were found floating on the surface or washed up along the shore. For a period the Night-Herons, acting as scavengers, disposed of them as they appeared, but later so many of the bodies were present that an effluvia arose from them in early morning, after the air had lain quiet over the surface of the lake during the night.

Along low marshy shores frogs (*Rana pipiens*) were fairly common while in spring holes back of the lake these were abundant.

Among mammals coyotes were fairly common, signs of an occasional badger, wild cat or skunk were found, porcupines were seen in the hills and deer were fairly common. The track of a wolf was observed on one occasion.

GENERAL DISCUSSION

Though a fair number of breeding individuals of various ducks inhabit Lake Burford in summer, it seems from observation, that in addition many drakes come there to molt and spend the summer after their duties of reproduction are completed. Males of the Cinnamon Teal, Mallard and Redhead were the first of these to appear, and, though not present at the time of my departure in large numbers, still it seemed that they were steadily increasing in abundance. A drake Cinnamon Teal, in company with a male Mallard, shot on May 27, had evidently finished breeding as the plumage was worn, the penis and cloaca reduced in size and the testes shrinking. On the following day six drakes of this species were observed in one flock, and from then on they were fairly common. Male Mallards consorting by themselves or with other drakes appeared May 27 and 28, and were seen in small numbers until June 10, after which they were common. One that was molting into eclipse plumage was observed June 4. Drake Redheads began to separate from the females on June 3, and after June 14 were common. In the case first noted of the Mallard and Cinnamon Teal drakes there can be no doubt but that they represented birds that had bred elsewhere, possibly at a lower altitude (though of course there is no means available for proving this) and had come here afterward to molt and spend the summer. No other deduction may be drawn from the facts outlined above, as at the time at which they appeared females of the same species were just beginning to lay at Lake Burford. The presence of such unmated birds as these shows that it is unsafe to rely upon a count of all drakes in arriving at an approximately correct census of the breeding ducks of any given area.¹ It is true that breeding drakes at certain times of the day (usually between 8 and 10 in the morning) are found alone, while the female is absent at the nest depositing an egg; and these drakes usually linger near at hand for a few days after the female has ceased to lay and has begun to incubate. (This statement may be qualified by adding that it is more often

¹The statements outlined here do not apply to the Ruddy Duck (*Erismatura jamaicensis*) as the drake of that species, like the male Canada goose, usually remains true to his spouse during incubation and the rearing of the young.

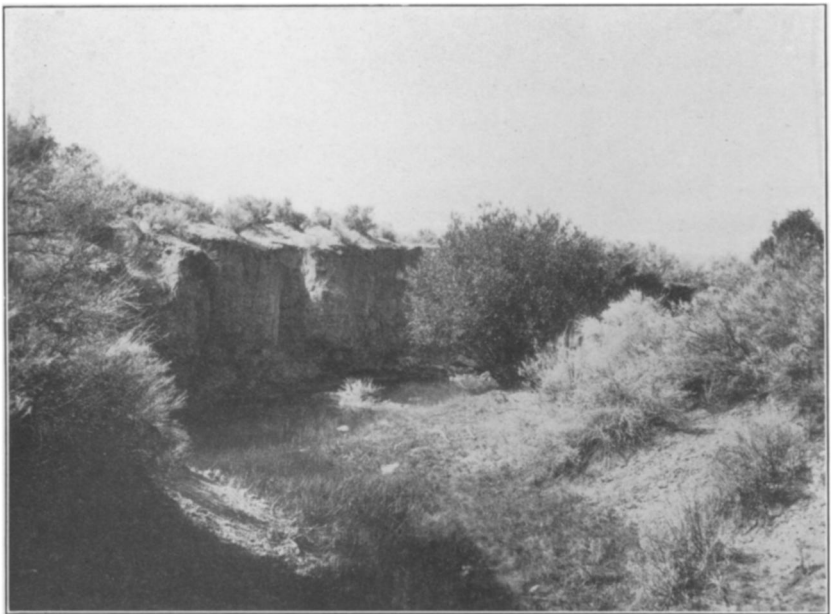
true of the "deep water" than of the "shallow water" ducks). These breeding birds however after a little experience may be told readily by their actions and demeanor, and seldom need be confused with those others whose duties of procreation are for this season completed. The mated birds when found alone are not far from the site of the nest, are more alert and watchful at the approach of an intruder, and often call a warning to the female. When flushed they may fly only a short distance and then drop into the water again, and in any case usually circle around and seem loth to leave the neighborhood. In contrast to this the summering drake nearly always seeks the company of others of similar status, so that little bands of these birds, often containing several species, may be found standing about on shore sleeping, preening or feeding. In demeanor these birds are more sluggish and when flushed usually fly off to some safe spot often a considerable distance away. Their entire manner and custom of life is wholly different from that of the bird still in company with his mate.

At Lake Burford these summering male ducks increased steadily in numbers until the time of my departure. Certain points and open beaches were favorite resorts with them, and there I was sure to find little flocks of males alone, or in company with a few pairs of mated birds. By the time when these birds must of necessity lead a sequestered life because of their inability to fly through the molt of their flight feathers, the two prime requisites of food supply and shelter would be present, as cover on the waters of the lake in the form of growths of the two species of *Scirpus* was steadily increasing while the great masses of potamogetons promised abundant food for them.

The lateness of the breeding season among the waterfowl here may be attributed perhaps to the slow development of a proper food supply. Until the first of June food suitable for these birds was far from common in the waters of the lake. A number of Mallards, and a few Cinnamon Teal and Lesser Scaup Ducks that I shot for examination for one reason or another were all thin and poor, and had very little fatty tissue underlying the skin. A female Ruddy Duck was the only individual examined that was fat in any degree. It is possible that this poor physical condition might retard physiologically the sexual maturity of these birds



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1. Growths of tules furnishing shelter for water birds. (Lake Burford, N. M.)
2. Water hole in gully near cabin at Lake Burford.

and so postpone the breeding season until a period of comparative abundance had been reached. It would seem that this scant store of energy must tell heavily on the females who were under the necessity of drawing upon their reserves of strength in producing a number of eggs. The close of the breeding season finding the birds thus reduced brings another call upon their vitality, in the renewal of their covering of feathers. It was observed that female Mallards were renewing their body feathers at the same time that they were mating and laying eggs.

The occurrence of the Lesser Scaup Duck at Lake Burford was of especial interest as, though the birds were present in fair numbers they were not breeding. These ducks were observed first on May 25, when a few apparently were mated. The mating display was observed on several days, and the birds were seen in copulation occasionally during the first week in June. Two pairs that were under observation frequented one area of rushes and the females gave the usual alarm note when I came in sight. Careful search failed to reveal a nest and finally I shot both females, one on June 17, and the second on June 18. Dissection showed that while the ovaries in these two were apparently healthy, as they were clear and normal in color, there was no physiological development in ovary or oviduct, and careful examination showed that the birds had not laid this year nor would they have done so if unmolested. The reason that these ducks remain so far south is puzzling. In many cases such ducks are cripples as I have taken summering birds at such southern localities as Lake Koshkonong, Wisconsin, Minco, Oklahoma, and the Laguna de Guánica, Porto Rico, at the end of the month of May and during the first part of June and have found that they showed the scars of old wounds. Here at Lake Burford, however, the birds were present in fair numbers, and were able to fly without difficulty when approached, and the two females collected showed no sign of injury of any kind. The males observed were all in full handsome plumage. It may be suggested that part at least of these ducks do not breed until they are two years old, and that some of these may remain in southern localities, lacking the physiological incentive for the flight to the breeding ground in the north.

An interesting case of sterility in a female duck was encountered in collecting a small series of Mallards, to be preserved as speci-

mens. On June 15 I had a pair of Mallards under observation for some time and from their actions was certain that they were mated as the female remained constantly near the male and the two had all of the mannerisms of mated birds. A short time after I came nearer and finally shot them both. On dissecting the female I found that the ovary showed little or no development while the ova exhibited the diseased condition known as black atrophy, an affection that is little understood, but one that is known to render birds sterile. The oviduct in this Mallard could be barely distinguished and showed no development whatever, though in healthy breeding females taken at this same time the oviduct was greatly enlarged, and exhibited the condition of turgidity common to the breeding and laying season. The male that accompanied this female was molting rapidly into eclipse and had already lost much of the breeding plumage. On examining the sexual organs in this bird I found the cloacal portion still swollen and enlarged, but the testicular substance degenerating so that it had been resorbed to a point where the testes were shrunken to one-fourth of the full normal size.

The instances outlined here are a further example of the care necessary in allotting ducks as breeding in certain localities simply because of their presence there in breeding season. This would apply especially to more unusual records in extension of range. Further observations on the occurrence of mated sterile females among ducks and other birds are of importance and the question is one that will repay careful investigation.

MIGRATION

At the time of my arrival there was still some movement in migration both among the smaller insect-feeding passeriform species and the larger water birds. Cliff swallows were not observed until May 25, Western Warbling Vireos arrived about May 31, and Orange-crowned Warblers, June 2. Grinnell's Waterthrush was seen on May 23 and 25, and the Pileolated Warbler on May 26 and June 2.

A few observations seem to indicate that Lake Burford is on one of the lines of flight for birds passing to and from the Salt Lake Valley, Utah. Snowy Herons observed at the lake at intervals

from May 23 to June 5, were certainly on their way to the mouth of Bear River, Utah, as that is the only breeding colony of these birds in the interior in this general region. A flock of Franklin's Gulls in full breeding plumage frequented the lake from June 14 to 16, and it may be that these were in passage to the same place as the time of their departure coincided with the arrival of a part of the breeding birds on Bear River; while apparently there is no intermediate region where they may nest. It may be supposed therefore that part of the ducks that come to Lake Burford in the fall come down from the Salt Lake Valley and use this lake as a resting place before passing on farther south. It is probable that this lake is merely one point in a broad line of flight that covers western New Mexico and the most of Arizona wherever water is found.

ANNOTATED LIST OF BIRDS

1. ***Colymbus nigricollis californicus*** (Heermann). EARED GREBE. The Eared Grebe was the most abundant of the breeding marsh birds at Lake Burford and while the species was common when work was first begun at the lake it increased suddenly in abundance between May 30 and June 1. Many of these Grebes were seen in pairs on my arrival, but until June 2, small flocks containing unmated birds of both sexes were found in certain of the open bays. As the season advanced these birds showed more activity, and after June 5, the Grebes were always found in pairs, that rested on the water with male and female never separated far from one another. Many were seen in the open water, some near shore and others farther out, while other pairs frequented the shelter of the fringing tules. All were tame and showed little fear so that when I remained quiet I had no difficulty in watching them, often at a distance of only twenty or thirty feet. They were without question the most interesting birds on the lake and were continually revealing new habits and mannerisms so that the watcher was certain to be repaid for any time spent in observing them. The displays witnessed during their mating were perhaps of the greatest interest.

The most striking of these courtship displays was one similar to that styled the "Penguin" attitude by Julian Huxley in his studies of similar actions in the Great Crested Grebe of Europe.¹ I was fortunate in witnessing this daily in whole or in part during my stay at Lake Burford. At the beginning of this, one of the most characteristic acts in the courtship of the Eared Grebe, the two birds, male and female, usually rested on the water five or six feet apart. Suddenly the male assumed an attitude fac-

¹Proc. Zool. Soc. London, 1914, pp. 491-562, 2 plates.

ing the female with crest and cheeks flaring, head erect, neck extended slightly forward, wings half opened with the tips raised so as to display all of the handsome markings to the best advantage. The female then dived, remaining under twelve or fifteen seconds, while the male maintained his position watching intently. As the female emerged she came up slowly a few feet away with head and neck extended until when free of the water she was standing bolt upright on the surface, treading water rapidly, with her whole body exposed. Sometimes she came up facing the male, sometimes with her back toward him and sometimes behind him. On perceiving her he rose at once, assuming the same attitude as that held by his mate, and the two, still bolt upright, advanced slowly toward one another, until finally their breasts touched, when their feet, suddenly moving more rapidly, broke at the surface, making a great boiling in the water. This performance was accompanied by constantly varied trilling and whistling notes. The birds held this upright position for a few seconds with heads turning rapidly from side to side as if pivoted on the neck, then sank slowly down to the usual resting position on the water, and at once began to preen the feathers of the sides of the breast and neck. This ended the display and the birds drifted slowly apart. The performance as described was the completed act. Frequently however after birds has been paired for some time they rested on the water facing each other, then rose at once to the upright position, and touched breasts, while calling excitedly, after which they sank back and began to preen. The boiling, rushing sound made by their feet as their breasts touched could be heard for a long way and often attracted attention to pairs in the open water at some distance that were just completing this display. Sometimes the male continued erect after the female sank back, and might then turn his back to her and travel off across the water for two or three feet. Again the male at times rose in display and the female did not respond when he sank back slowly after a few seconds. In one variation of the action I saw a male emerge very slowly in front of his mate with wings partly raised, submerge, and then rise again. The third time he emerged in the erect position but she did not respond when he sank back again on the water. The entire display was seen at comparatively long intervals but the simplified version in which the two birds merely rose together was observed many times each day. The entire act required from 10 seconds to nearly a minute to complete. As the birds stand bolt erect their resemblance to small penguins while performing this act is both curious and striking.

Another very pretty display was as follows. A pair rested on the water 8 or 10 feet apart and then swam slowly toward one another, suddenly checking to a standstill when their bills almost touched. They remained for a second or two in this position and then both turned half around so that their tails were almost touching, and the birds were facing away from one another. The male then depressed his crest, lowered his head and nodded it slowly back and forth, looking at the surface before him as though

examining a nest and eggs, while both gave a low trilling note that continued for some time and was very pleasing. As the season advanced this action became more and more common, and when nest-building began the male performed in this way over the nest foundation constantly. The female now became more active, frequently rising half erect at short intervals, arching her neck with head bent toward the breast and then giving a sudden quick spring forward, seemingly imitating the action of sliding up on a nest platform.

In another action male and female rose from the water, and, standing half erect with the male slightly behind but with his breast touching the female's side, rushed off across the surface for six or eight feet calling excitedly. At other times a pair lay prostrate and travelled off on the water with necks extended and wings spread and flapping. Or males alone rose on the surface and with neck bent forward, crest and cheeks expanded, and flapping wings, ran along in a straight line or in a semicircle sometimes for a hundred feet. I thought also that part of the love making of these birds took place beneath the surface of the water as mated pairs often dived together and remained below for some time. It was a common thing for a male to follow a female under as she dived and at times males showed attention to females by diving from a few feet away and coming up immediately beside them.

Rival males often threatened one another by half extending their wings and then closing them for two or three times as they faced one another, or ran at each other striking with their bills. The attacked bird in this case usually dived to escape. In their squabbles they seemed often to endeavor to strike the feet of an opponent, apparently a tender place, as the attacked bird always dived. Occasionally I saw one spring clear from the water at another to land on his back and slide off. Females too fought to some extent when their mates paid attention to others, and struck vigorously with their bills, doing more real fighting than did the males, who often merely blustered and seldom really came to blows as the one attacked usually dived avoiding a direct encounter. Preening the sides and breast was a constant accompaniment of any mating display.

On cold, sharp mornings, when the temperature was near freezing, these grebes frequented sheltered bays away from the wind, and floated about on the surface with their backs to the rising sun, the feathers of back and flanks expanded, the wing tips raised, and the whole plumage fluffed to receive the warm rays to the fullest degree. At these times the birds looked as large as Mallards or Gadwall. The sudden change to the usual slim form just before the birds dived was almost startling. Frequently when at rest the birds drew one foot up among the flank feathers, and floated about paddling slowly with the other. Often they stretched after resting, extending first one foot and then the other straight back and free of the water. I saw them feeding by swimming slowly along with neck outstretched, seizing Chironomids floating on the surface film with quick

jabs of their sharp bills. Often as the grebes neared these flies they gave a quick stroke with the feet in order to drive ahead and seize them before they were disturbed by the wave that preceded the bird when swimming at a regular rate.

Though these grebes were paired early, actual nest-building did not start until about June 13, though a few females were seen in Hayden's Lake playing with nesting material as early as the first of June. Nests were begun where the water was from three to five feet deep. The females seemed to do the work of nest construction, dragging up masses of algae to a central point and diving actively for more while the males remained near the nest posturing over it trilling and reaching out as though to aid the female as she approached with building material. A colony of a dozen or fifteen nests was begun at one point in the lower end of the lake, and the grebes were noisy and demonstrative here for several days before actual building begun, displaying constantly and fighting with rivals. The noise and commotion continued as nest construction was started. No completed nests were found nor were any eggs laid up to the time of my departure.

The notes of these grebes were whistled and somewhat varied but were of such a nature that it is difficult to transcribe them successfully to paper. Males were heard occasionally making a curious southing sound concerning whose origin I was uncertain. Occasionally during the night, especially when the weather was stormy the Grebes called in chorus making a considerable volume of wild sound that carried for a long distance.

After the first of June, when insect life became more abundant, little parties containing from six to fifteen of these grebes came swimming up from the lower bays toward dusk each evening to feed in the great open expanse of water at the northern end of the lake. These bands swam steadily ahead in close formation toward the open water, without stopping to rest. Little flocks travelling a hundred yards or so apart continued to come until it was dark. Occasionally as they passed a single grebe came out from the rushes on either side to join them. Frequently I counted 150 or 175 individuals before it became too dark to see clearly. The broad area of water mentioned proved a trap for many insects that came flying out from the sage grown hills surrounding it, while Chironomids and Ephemerids were emerging constantly from its shallow depths in great numbers. Frequently in the morning I found the water surface strewn with drowning beetles and ants, while gnats were resting everywhere on the surface forming an abundant source of food.

After leaving Lake Burford I visited a lake region at an elevation of nearly 9000 feet on a high plateau in the southern end of the Chuska Mountains. The Eared Grebe was found here also and was nesting in fair numbers on the two lakes known to the Navajos as Be-e-khet-hum-ñez and To-teh-khih. Though these lie at two thousand feet greater elevation than Lake Burford breeding among the grebes was much farther advanced.

On July 1, I examined a colony of about forty nests and found that the young had hatched in about two-thirds of them while the eggs in the remainder were heavily incubated. The nests were grouped in a growth of *Scirpus occidentalis* from twenty to thirty feet apart. They were the usual rounded masses of decaying vegetation built up two inches above the water with a slight hollow in the top to contain the eggs. Some had been partly covered by aquatic vegetation drawn up by the parent birds before leaving, while in others the eggs lay in the open with no attempt at concealment. Apparently the young leave the nest as soon as hatched as though I found broken eggshells in which the membranes were not yet dry, the young were nowhere to be seen. Adult grebes swam ahead of me through the water plants, diving when I came too near, but not seeming greatly alarmed. Often they were accompanied by young ten or twelve days old that swam close behind, almost touching the body of the adult bird or climbed upon the back of the parent to be held beneath the wings while the old bird swam away. Adults were seen feeding these young, calling them up across the water and placing food in their bills. These juvenile birds had a wrinkled space of thickened reddish skin bare of feathers on top of the head.

2. **Podilymbus podiceps** (Linnaeus). **PIED-BILLED GREBE**.—This species was common at Lake Burford and was breeding. Though part of these birds were pairing when I first arrived some were nesting already and all bred earlier than did the Eared Grebes. Their actions were no less interesting than those of the preceding species but these grebes were somewhat more difficult to watch. Each male had selected a restricted area as his own and though he made excursions occasionally out into the open lake, was usually to be found near one certain place. Usually this was a small opening in the rushes fifteen or twenty feet across, often with a slender line of tules projecting in a point that separated a little inner bay from the open water. Ordinarily the male was found in the slight protection of the slender tules or in the open a short distance outside while his mate lay hidden somewhere within. These birds were continually on the alert and watched every move on the marsh, swimming slowly or resting quietly, always with their short tails pointing up at an angle of 45 degrees to display the white below prominently. They were the only marsh birds of whom the male coots seemed to be afraid, and it was seldom that a coot ventured to attack one, though pugnacious to an extreme toward most other swimming birds, a respect that was well warranted as the grebes were aggressive and savage. These male grebes called at short intervals, listening to others at a distance and frequently answering them. Their notes were loud and sonorous, and in calm weather could be heard plainly across the water for half a mile but could be modulated and controlled also so that though the birds were only a few yards away the sounds seemed to come from a great distance. The most common note was a loud *coh coh coh coh coh coh cow cow cow cow*, the first series of notes increasing

in rapidity as they progressed and the last given more slowly with equal intervals between them. This was varied to *coo-coo-coo-coo-qua*, *coo-coo-qua*, *coo-coo-qua* continued for some time, the *qua* note being prolonged and with a curious rising inflection. These calls often were given while the bird was in the open. The head and neck were held erect in calling and as each note was uttered the bill was thrown up. Another note given usually from the shelter of the rushes was a loud laughing *hah hah hah hah hah hah*, that was harsh and raucous to an extreme. In addition to the calls described above they occasionally uttered a peculiar low whistled note.

The mating displays of this species while not as varied as those of the Eared Grebe were strange and interesting. A pair resting quietly in open water sometimes dived and then came up to splatter off for a hundred feet or so, across the surface with flapping wings with the male in pursuit of the female and about ten feet behind. At the close of this the male gave a series of loud sonorous calls. Frequently he nipped off a length of tule stem twelve or fifteen inches long, holding it by one end in his bill, while he swam about or even dived. Again a pair swam toward one another with heads and necks held erect. When about a foot apart they stopped and then swung half around and presented their tails to one another. At the same time the male held his wing tips slightly raised, the feathers of his back elevated and the sides of his neck puffed out while both birds turned the head alertly from side to side, though seemingly they regarded some distant object rather than each other. In a second or two they swung back, facing one another again, continued this turning half around and then back, as though pivoted in one spot, at ten or fifteen second intervals for nearly ten minutes. The male was more regular in turning than the female and she was frequently out of time with him. Finally the female lowered her head while the male continued to display for a few seconds longer, after which the two swam back into the shelter of the rushes.

When at rest these birds spent much time in preening and when feathers were loosened in this process (as many were) they were seized, dabbled in the water and swallowed. Eared Grebes did the same but often tried to shake the feathers free from their bills, usually not swallowing them unless they adhered, though I saw one Eared Grebe discard a feather which was immediately picked up and swallowed by its mate.

The Pied-billed Grebes like the preceding species sunned themselves by resting in sheltered bays with their feathers fluffed out. In doing this they floated with their backs to the sun with the wing tips and feathers well elevated to catch the warming rays so that at a distance they looked very large and bulky.

On June 18, I found a brood of newly hatched young near the lower island in the south lake. As I approached the rushes bordering the shore a female Grebe swam out calling *cuh kow cuh cuh cuh* and at intervals, rising threateningly on the water, made a great boiling noise by treading



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1. Grove of narrow-leaved Cottonwoods (*Populus angustifolia*) near Lake Burford.
2. Mouth of gulch above Lake Burford showing Yellow Pines (*Pinus brachyptera*).

rapidly with her feet. After a few minutes four young swam out from the shelter of the rushes and joined her, calling with loud whistled notes. She swam slowly away followed by the young who one by one succeeded in clambering onto her back beneath her wing feathers so that soon she was carrying all four. She did not seem to realize this however as several times she rose and shook herself throwing them all into the water again, when they climbed back as rapidly as possible. Finally she dived once carrying the young with her, and then again, leaving them on the surface. The young were able to swim rapidly with the head extended and the base of the neck and forepart of the body entirely submerged in the prostrate attitude common to young grebes. They dived when pursued, and swam away under water, or hanging suspended five or six inches below the surface, watched me intently. One or two soon became tired, and, attracted by the moving boat, swam over and attempted to clamber up the side. One in diving became entangled in algae and had to rise to the surface where it remained helpless. All were able to stay beneath the water for considerable periods but were captured without difficulty. On land they progressed by a series of leaps made with both feet together and wings extended, at each jump falling forward on the breast. The female disappeared after leaving her young, while the male remained in the rushes calling at intervals while I examined them.

These grebes at times were very pugnacious toward the smaller Eared Grebes, driving them about and diving to bite at their feet. At times they were seen in pursuit of Coots and Ruddy Ducks.

3. **Larus delawarensis** Ord. RING-BILLED GULL. Immature gulls of this species were seen on May 24 and 30, and June 5, 6, 7, 14 and 17. One or two were probably present on the western side of the lake during the entire period as the birds were seen there on the occasion of every visit. There was no indication that they were breeding or intending to breed.

4. **Larus franklini** Richardson. FRANKLIN'S GULL.—Fairly common in migration. Two adult birds in full plumage were seen on the western shore of the lake on June 6. On the morning of June 11, fifteen or twenty were scattered about at daylight, resting on the lake in front of the cabin. All were in immature plumage but were molting into adult dress. One was taken. On June 13, about twenty more were circling about low over the water so that at first they were taken for terns. On the following day a flock numbering thirty or more in full adult plumage appeared and remained until June 16. They were wild and would not permit near approach. In the evenings they spent much time in aerial evolutions that were beautiful to watch. They worked upward in spirals, alternately flapping and soaring, maintaining a close formation until suddenly all set their wings and rushed downward for several hundred feet making a great roaring noise. Rising again they often separated into three or four smaller flocks that alternately joined and separated,

continuing these antics until dark. Another immature bird was taken on June 15.

5. **Hydrochelidon nigra surinamensis** (Gmelin). AMERICAN BLACK TERN.—Three were seen on June 6, apparently in migration.

6. **Pelecanus erythrorhynchos** Gmelin. AMERICAN WHITE PELICAN, A few were found in migration. Two were observed on May 26, two on May 27, and four on May 28, all resting on shore. It is possible that these birds were on their way north into the Salt Lake Valley. There is no food for them at Lake Burford save the abundant water-dogs (*Ambystoma* sp.).

7. **Mergus americanus** Cassin. AMERICAN MERGANSER.—Found at Lake Burford during migration. A small flock was seen on May 27, and fourteen pairs were observed on May 30. These remained in open water and were very wild. On June 3, four males and two females were found. They flew and left the lake immediately when I came in sight though a long distance away. On June 10, twenty-five males all in full plumage came in, flying in a great V, circled over the lake, and then passed on. An adult male was flushed from the shore on June 15. There are no fish in the lake so that these birds must come here for water-dogs (*Ambystoma* sp.).

8. **Anas platyrhynchos** Linnaeus. MALLARD.—The Mallard was one of the most common species of ducks breeding at Lake Burford and I estimated that forty pairs were preparing to nest here this season. These ducks shifted about from place to place more than any others on the lake, and were seen flying morning and evening. Towards night they came in to feed where openings in the rushes allowed them to reach the shore, where they secured food that had been washed in by the waves. At daylight nearly every morning I found a pair feeding in the spring hole where we secured our water supply. About eight in the morning the birds came out on little open beaches and remained until towards noon, preening, sleeping and resting in the sun.

Mallards are undemonstrative birds and, though they were under observation during much of the time that I was out, it was seldom that I saw any sign of mating display among them. This species has a mating flight, similar to that of the Gadwall, in which two males and one female rise in the air together and fly along rather slowly with the female flying beside first one and then the other of the males. In turn these swing in ahead of her and setting their wings throw up their heads and display their back and wing markings. During this performance the males call constantly while the female quacks at intervals. The whole lacks the dash and speed of the display of the Gadwall and the birds do not change direction so frequently, pursuing a more even course. In another action the female came out on shore and walked about in the short grass with head extended quacking loudly, perhaps simulating a search for a nest site. Sometimes the male accompanied her and sometimes he remained standing quietly on shore.

From their actions I believed that some of the females were laying on May 29. A female that was just beginning to lay was taken on June 7, and birds that had deposited several eggs were shot on June 8, 13, 14 and 15. One taken June 14, had the breast nearly denuded of down. A mated female that was sterile was taken on June 15. While females were at the nest the males remained from a hundred yards to a half mile away standing on shore or swimming in the open water. These males were alert and called instantly at the approach of danger. On one occasion I shot a female for preservation as a specimen as she rose from the border of the lake and her mate came over and swam up and down out of range for several minutes calling anxiously.

As early as May 29, drakes that had finished breeding were banding together and it would seem that they must have bred elsewhere. Following that date these males were found daily, alone or in small flocks, and their number was augmented steadily by others. They were usually found resting or sleeping on shore in open places in company with drakes of other species. A bird that was molting into eclipse was noted on June 4, and from then on birds in changing plumage were common. In this molt they become dull in color first about the head and at the same time lose the recurled upper tail coverts. A male almost entirely in eclipse plumage was seen on June 18.

On June 18, I saw a Mallard's egg that had been stolen apparently by pack-rats (*Neotoma*) as it was found on a small island where there was no other sign of predatory animals. The contents of this egg had been neatly extracted through a hole at one end and the shell laid in a low growth of *Chrysothamnus* with small flat bits of sandstone placed around and over it nearly concealing it. It might seem that this was the work of boys save that the egg was found on an island inaccessible save by boat, and the only boat on the lake was in my possession.

The female Mallards taken were nearly all molting the body plumage and the new feathers that were coming in were very dark. These birds differed from northern and eastern Mallards in the color of the bill also. This was in general dull greenish slate with the base of the maxilla dull orange while the tip of the bill often inclined to dull plumbeous. The naked inter-ramal space was tinged with orange. In one or two there was a dusky blotch on the culmen, but I examined none with the prominent blackish spots on the orange at the base of the bill so prominent in females of this species elsewhere. The toes and tarsi were dull orange. The bill of these females in a way resembled that of the males but was duller in color.

(On May 25 a large very dark-colored duck in company with a mated pair of Mallards passed me several times at close range. It had white bars on either side of the speculum and was much darker in color than the female Mallard, resembling a Black Duck markedly. It is possible that this was a female mallard, but it seemed to have a clear olive green bill

and was larger, thus resembling a male of the Black Duck group (possibly *A. diazi*). No other ducks of this type were observed).

9. ***Chaulelasmus streperus*** (Linnaeus). GADWALL.—The Gadwall was the most common of the shallow water ducks at Lake Burford, outnumbering the Mallards, as it was estimated that about 60 pairs were breeding there. The birds were all in pairs at the time of my arrival but appeared to nest late as males continued with the females until the time of my departure. They shifted about more or less during the day but in general were distributed all along the lake shore. On one occasion fifty flushed in a flock from a shallow open bay and for a few seconds all were in confusion. At once, however, the flock began to divide, and before they had gone 150 yards all had separated out in pairs and flew off in that manner.

The mating flight of the Gadwall is always interesting and is seen constantly when the birds are on their breeding grounds. Here at Lake Burford opportunities for observing it were excellent. The flight was usually performed by two males and one female. In beginning two males approached a female in the water, calling and bowing. She usually rose at once and flew with a slow flapping flight, mounting in the air with the males in pursuit, calling and whistling constantly. First one and then the other of the males swung in front of her, set his wings, inclined his body upward to show his handsome markings, and, after a few seconds, dropped back again to his former position. Late in the season there was always one of the males who was favored and who displayed more often than the other, flying close to the female, so that in passing his wings often struck hers, making a rattling noise. After a short time the second male often left the pair and returned to the water. The birds frequently mounted until they were 300 yards or more in the air, and darted quickly from side to side, flying now rapidly and now slowly. When the flight was over the birds descended swiftly to the water again. I was never able to ascertain whether there were some extra males about or not, as, though, there were usually two with the female in this flight I found them at other times always in pairs.

The female Gadwall, like the mallards, also came out in the short grass of the shore and walked about with head down, quacking loudly, an action that I took for part of the mating display.

When the birds were in the shelter of the rushes they went through other mating actions of interest. The male swam toward the female bowing by extending his neck until the head was erect and then retracting it, bringing his bill down onto his breast. He then approached pressing his breast against the sides of the female and shoving her easily, first on one side and then on the other, biting her back and rump gently as he did so. After a few seconds she lowered her body in the water and copulation took place with the female entirely submerged save for the crown of her head while half of the body of the male was under water. As the female emerged the male turned immediately to face her and bowed deeply, giving a deep reedy call as he did so.

Gadwall fed in the water by tipping, or occasionally came out on shore to walk along and skim the surface of the mud with their bills as do Green-winged Teal. Like the Mallards they usually spent the morning in resting and sleeping in the sun on some open point.

The call note of the female is a loud quack that is similar to that of the female Mallard but is pitched slightly higher and is not quite so loud and raucous. Considerable experience is required however to distinguish with certainty the calls of the two birds. The male has a loud call like *Kack Kack*, a deep reedlike note resembling the syllable *whack*, and a shrill whistled call.

Females were laying as early as May 29, but no nests were discovered.

10. **Mareca americana** (Gmelin). BALDPATE.—There were two pairs of Wigeon that were apparently nesting at Lake Burford and single males were seen occasionally. The birds were tame and often allowed a close approach.

The mating flight of this duck resembles that of the preceding species, but is performed with more dash and speed. The birds fly swiftly and erratically. The males dart ahead of the females, setting and decurving their wings and throwing their heads up, exhibiting their striking markings to the best advantage. The female calls *qua-awk*, *qua-awk* and the males whistle *whew whew* constantly during this performance. Occasionally as a pair swung in low over the water the male darted ahead and, with decurved wings and head thrown up, scaled down to the surface. Two males and a single female invariably took part in the display flight which began as in the Gadwall by the males approaching the female, bowing and whistling and then following her as she rose in the air.

The birds were observed swimming in open water or feeding in shallow bays by tipping to reach the bottom. They were seen with other ducks sunning themselves on open points in the mornings.

11. **Nettion carolinense** (Gmelin). GREEN-WINGED TEAL.—Five pairs of Green-winged Teal were found at Lake Burford. These birds were found resting on shore with other ducks or feeding by walking about on mud bars like great sandpipers skimming with their bills over the surface. The call note of the males is a musical whistled note resembling *pheep* to an imitation of which they responded readily. The females call *quack*, *ka-ack*, *quack* in rather a high tone. Female birds were apparently laying as they were seen in areas of heavy dead grass and rushes, and called anxiously when I examined these, but no nests were found.

A few drakes that apparently had nested elsewhere appeared on June 14, and from then on they accompanied flocks of males of other species of similar habit, resting with them on open beaches and sandy points.

12. **Querquedula discors** (Linnaeus). BLUE-WINGED TEAL.—A pair of these teal was seen on May 25, and another on June 3. About June 15 they became slightly more common and it was estimated that four pairs were breeding here. Single males appeared on June 11, and

others on June 14, after which they were found regularly in company with other drakes. On June 14 one fed for some time on the open shore in front of a blind where I was concealed. This bird walked along working eagerly in the mud with its bill with all of the mannerisms of the Cinnamon Teal. The call note of the male Blue-wing is a high-pitched *tseef tseef tseef*, entirely different from the notes of the other male teal with which I am familiar.

13. **Querquedula cyanoptera** (Vieillot). CINNAMON TEAL.—The Cinnamon Teal was common at Lake Burford. One pair frequented a marshy area near my boat landing and was seen in the rushes, or resting on shore, constantly through the day. On one occasion two of these Teal were trying to feed along a rush grown shore where a male Coot had taken his stand, but he drove at them savagely time after time whenever they came near, forcing them to take wing and fly a few feet to evade him.

A single drake of this species that was shot on May 27, when in company with a male mallard, had evidently bred this year, and after that date summering males were fairly common. It was supposed that they had bred at a lower altitude and had come up here to spend the summer, as resident birds at Lake Burford were just beginning to lay. On June 6 toward dusk one flock of six males of this species, and later a second flock of seven, came in to the lake high in air, circled about, and alighted in the water. Apparently they had just arrived from a distance.

These single males persisted in paying attention to females already mated, much to the disgust of the paired drakes, who drove them away, bowing at them and chattering angrily. On one occasion six were seen making demonstration toward one female who paid no attention to them, but followed her mate. He swam first at one and then another after each chase returning to his mate and bowing rapidly, while occasionally she bowed to him in return. After a few minutes another mated pair of teal flew by and four of the males flew off in pursuit of them, leaving the first male only two to combat.

The only note that I have ever heard from the male Cinnamon Teal is a low rattling, chattering note that can be heard only for a short distance.

14. **Spatula clypeata** (Linnaeus). SHOVELLER.—The Shoveller was fairly common at Lake Burford and fifteen pairs apparently nested here. On May 27, about forty pairs were feeding on the small lake known as Hayden's Lake but these birds were thought to be in migration as they disappeared at once. On the large lake, Spoonbills were found in shallow bays, in which the shore was open or with only scattered rush growth, where they fed by submerging the head and working through the mud at the bottom.

Males bowed to their mates, in the same way as do the Cinnamon Teal, by extending the neck straight up and then retracting it with the bill held slightly above horizontal. At the same time they often give a low rattling note like *chu-uck chu-uck*. The females usually responded by bowing,

but in a less exaggerated manner, simply jerking the head up and down. The whistling noise that accompanies the start in flight with these birds is made apparently as they gain momentum by beating the sharply pointed wings rapidly after their first spring from the water.

15. **Marila americana** (Eyton). REDHEAD.—The Redhead was a common breeding bird at Lake Burford and 30 pairs were located that seemed settled for the summer. These birds were found mainly in the small bays in the southern part of the Lake where they swam in the open water or rested and slept on shore. Small flocks were seen standing on the open beaches about sandy points every morning sunning themselves or preening their feathers. It was interesting to note that, while the shallow water ducks paid no attention to me unless I came near, the Redheads always waddled into the water and swam out into the open as soon as I appeared even though I might be half a mile away.

The peculiar mating display of these birds seen on several occasions was observed to advantage on June 4. A party of four males and three females were swimming in open water, two of the birds apparently being mated. Suddenly one of the females began to display, approaching one of the males with her head held high, sometimes jerking it up and down and again holding it erect, and at intervals calling *quek que-e-ek*, the last a peculiar rattling note. The male chosen extended his neck, holding his head erect, frequently whirling quickly to show the female his back, or again sank down with his head drawn in while the female bowed before him. At short intervals she opened her mouth and bit at him gently or, if he was swimming, sprang quickly in front of him with her head erect and back partly submerged. She transferred her attentions from one male to another in turn, even approaching the one who apparently was mated. The males showed considerable jealousy over these favors and drove each other about in fierce rushes. At intervals they called, the note being a curious drawn out groaning call, resembling the syllables *whew ough* given in a high tone. As it was given the male sometimes raised his breast, elevated his head and erected his crest. Again he threw his head straight back so that it touched his dorsum above the rump, with the throat up and the bill pointing toward the tail. The bill was then thrown up and head brought again to the erect position as the call was made. The curious actions of the male in calling continued after he was mated, and the strange call note was heard often. Mated males were seen driving savagely at their mates and biting at them while they escaped by diving.

On June 4, a nest containing eight eggs was found in a mass of dead *Scirpus* stems in a clump of tules below the cabin. On June 13 this nest contained 14 eggs and the female had added a considerable amount of down to it. The mate of this bird remained in the open water from a hundred yards to a quarter of a mile from the nest-site but was never seen to go near the nest. The female, who left the nest whenever she heard my boat approaching, always flew out to join him. He remained with her

until June 17, and then disappeared as she had been incubating steadily for three or four days. The nest in this case was built entirely of dead *Scirpus* stems and was deep and well protected. Fluffs of down adhered to the tules all about it so that the site was easily located.

Four single males were observed on June 6, and a flock of twelve was seen on June 8. After this males unaccompanied by females were common. Part were birds that had nested here and a part I believed came from elsewhere.

16. **Marila valisineria** (Wilson). CANVAS-BACK.—There were three pairs of Canvas-backs on the lake that from their actions seemed settled for the summer, but I was unable to find their nests. During the first two days of my stay a female frequented a small cove below the cabin acting as though she was nesting in the rushes but as she was constantly disturbed she finally left this part of the lake. On June 8, a female was seen swimming low in the water away from the rushes but in this case also I was unable to locate a nest.

On one occasion a female swimming after a male, quacked like a female Redhead but in a more subdued flattened tone. The males were silent. On May 27 while watching birds from a shore blind a male Canvas-back came around a point within 40 feet of me. He saw me and eyed me closely but did not seem at all afraid, and swam on past, at intervals dipping the tip of his bill in the water. A few minutes later as I stood up he rose and flew rather heavily, paddling with his feet for about 80 yards before being able to clear the surface entirely. Three pairs of these birds were flushed from a resting place on a rocky beach on June 15.

17. **Marila affinis** (Eyton). LESSER SCAUP DUCK.—There were ten or twelve pairs of bluebills and a few unmated males on Lake Burford during the entire time of my stay but none apparently were nesting. On June 1, I found 25 males and 23 females on Hayden's Lake, a part of them in pairs. These had evidently stopped here in migration as they passed on at once and were not seen again. The summering birds were found in the open bays and in the forenoon were often seen resting and sleeping on shore at open points. Like the Redheads they swam out to open water as soon as I came in sight even though I was a considerable distance away.

The birds were seen in display on several occasions and as in the case of the Redheads the more active part in this fell to the lot of the female. Parts of the mating actions were witnessed on a number of occasions while on June 3 the complete display was seen. A pair rested in open water in front of me when suddenly the female began to swim back and forth with the head erect, frequently jerking the tip of her bill up while the male drew his head in on his breast and lowered his crest, giving his crown a curious flattened appearance. The female turned alternately toward and away from the male, sometimes biting gently at him, while occasionally he responded by nipping at her with open mouth. At short intervals she dove

towards him, barely sliding under his breast, and emerged at once only a few feet away, or at times advanced toward him brushing against him and then turning away. A second male that tried to approach was driven away by quick rushes though the female paid no attention to him. She continued her diving and finally at intervals the male began to dive with her, both emerging at once. As the display continued he joined her under the water more and more frequently and finally both remained below the surface for over thirty seconds where copulation apparently took place. When they emerged the female swam away for a short distance with the male following her. Frequently during these displays the female gave a peculiar rattling, purring call like *kwuh-h-h-h* while the males whistled in a low tone.

The female bluebills seemed very anxious when they happened to spy my head in the rushes, and swam back and forth with heads erect and crests raised giving their peculiar calls. The males were more stolid and paid little attention beyond taking care to keep out of gun range. Several pairs were found about certain favorable places for nesting, and I was certain for a time that they were going to breed, a supposition fostered by the displays that I saw continually among them. Careful search however failed to show nests and when finally on June 17 and 18, I shot females that were paired and apparently nesting in points of rushes, I found that, though in normal physical condition, they had not deposited eggs, and, as the sexual organs were not developed, would not have done so this year. As this has been treated fully in the introductory portion of this report it will not be discussed further here save to state that the bluebill apparently should not be listed among the breeding birds of Lake Burford at present, though it seems possible that occasionally pairs may nest there.

Some of the unmated drakes exhibited great regularity in habit. Two in particular were found every morning resting near a certain clump of grass on one sandy point. All of the males observed were in full plumage.

18. ***Erismatura jamaicensis*** (Gmelin). RUDDY DUCK.—This duck was one of the most common at Lake Burford and it was estimated that 55 pairs were breeding at the lake. When I first arrived part of these birds had selected the areas where they were to spend the summer and were already mated. Others were found in little parties composed of both sexes in places where the rushes were too thin in growth to afford nesting cover, but by June 1, with the increase in growth of the rushes, Ruddy Ducks were distributed around the lake and seemed to be settled for the summer. From observations made here it would seem that part of these birds at least paired and mated after reaching their breeding grounds. Apparently in some areas there were more females than males.

The curious display of the males was seen every day and was observed to the best possible advantage, as frequently birds displayed within 30 feet of me. They seemed to keep up the curious performance constantly

all day long and sometimes displayed for half an hour or more when no females were near. As a matter of fact this action often began whenever I drove the males to open water from the shelter of the rushes. the manner of procedure was as follows. The male rested on the water with tail erect at an angle of 80 degrees. The head was then drawn in and jerked rapidly up and down several times with the bill depressed, so that the tip of the bill struck the side of the breast above the tracheal air sac¹ (present in the male alone) producing a curious clicking sound. The bill tip was gradually lowered until at the last it hit the breast feathers at the water line splashing the water into foam. At the same time the tail was drawn steadily forward past the vertical to an angle of 60 degrees on the opposite side of the arc, so that the tip came within one and one half or two inches of the head. At the close of this action the head was suddenly extended with the mouth open, and the bird emitted a low croak. The tail was then thrown back to the usual position and the bird resumed its normal attitude. In addition during the display the feathers of the crown were elevated at the sides and depressed in the center to form a deep V that was broad in front and more narrow behind. Sometimes birds held the crest thus elevated constantly, and again it was thrown into this form only as the last notes were given, when it was flattened immediately to the normal position. The sounds produced during the display may be represented by the syllables *tick-tick-tick-tickety quok*. The first series is not vocal but is produced by the bill striking the breast above the swollen air-sac, so that this sac is apparently used as a tympanum, a use which explains its development as a secondary sexual character in the male. The last note is vocal and is made up of two distinct elements or sounds uttered synchronously. One of these is a harsh frog-like note that may be represented by the syllable *quok* and the second is slightly drawn out, almost two-syllabled, with a reedy quality resembling the note of the male Gadwall. It was thought that this second note was made in the normal way by the syrinx, and that the first was caused by the expulsion of air from the tracheal sac, as a contraction of the dermal muscle known as the *cucullaris* above the sac was plainly evident through movement of the skin of the neck as the duck extended his head and made this last sound. As this note was given the tips of the wings were elevated for two inches or more, so that it seemed possible that the carpal joint of the wings pressing against the sac (which occupies the whole front of the neck above the breast) aided in expelling air from it.

Males were seen constantly swimming after the females, checking to give the display, and then continuing on. At a distance they resembled absurd little manikins with quick jerky motions controlled by the pulling of strings. At short intervals the males extended their heads on the sur-

¹cf. Wetmore, A., Proc. U. S. Nat. Mus. Vol. 52, 1917, p. 479; and Condor, Vol. XX, 1918, p. 19.

face and flapping their wings made a quick drive forward for three or four feet making a great boiling in the water with wings and feet. Immediately they resumed the erect position and began the display again. Females were rather shy and when pursued too closely escaped by diving.

Males exhibited considerable jealousy and lowering their tails continually drove at one another, the attacked bird usually diving to escape. Occasionally however he stood his ground when the oncoming male either checked and retreated, or occasionally sprang from the water striking on his opponent's head or back with his broad feet and then sliding off. Often the two remained close together striking at one another with their big feet. This was about the extent of their fighting, at which I was somewhat surprised as young birds when two thirds grown are very pugnacious when handled.

By June 5, a considerable number of Ruddy Ducks were in pairs and swam about when driven from the rushes with the male displaying and the female following him. Females then sometimes gave a curious imitation of the display of their mates, swimming with tails in the air, jerking their heads up and down and then extending the open bill, either without making a sound or at most uttering only a falsetto *qua-er*. This odd mimicry was given at times by females that apparently were unmated. At times some of these female ducks produced quite a rattling noise by striking the tip of the bill on the breast, a sound however that was entirely different from that produced by the male. Males were seen in company with several females as late as June 8. After June 10 the amount of energy spent in display lessened somewhat.

Females were often rather nervous over my presence in the rushes and swam back and forth calling *whap* or *quep* in a curious flat tone. Another note heard from them was *Keow Keow* in a high tone, a one-syllabled call somewhat similar to that of a hen turkey. The breeding season with these birds apparently is late as a female shot on June 18 was not yet laying though the ova were enlarging and the oviduct was about half developed. No nests of this species had been begun at the time of my departure.

These birds in preening the feathers of breast and abdomen stood erect in the water treading rapidly with the feet while they did so. Bluebills and other deep water ducks usually lie over on the back or side in order to dress the feathers of the underparts.

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(To be Concluded)